Idaho Department of Environmental Quality

SCIENTIFIC BASIS FOR THE CONTROL OF AMMONIA FROM DAIRY FARMS BEST MANAGEMENT PRACTICES

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This bulletin is to assist dairy farmers in understanding the terms used and the scientific basis for the best management practices (BMP) listed in the Idaho Department of Environmental Quality's Rules for the Control of Ammonia from Dairy Farms located at IDAPA 58.01.01.760 through 764 (hereinafter "the Rule"). This bulletin will be reviewed annually and revised if necessary to reflect any new information, including any changes to the Rule.

The Rule was developed for dairy farms that emit an estimate of 100 tons per year or more of ammonia. The threshold values were derived from manure excretion tables prepared by the American Society of Agricultural and Biological Engineers and the USDA – Natural Resources Conservation Service and were agreed upon by the Idaho Dairymen's Association (IDA) and Idaho Conservation League (ICL). In addition to manure excretion, the IDA and ICL took into account their best professional judgment to account for differences in ammonia losses from various dairy housing types, manure storage systems, and land application practices. The table below, located at IDAPA 58.01.01.761, represents the scientific findings established in The Dairy Air Emissions Analysis: Focus: Ammonia Emissions for Typical Dairy Management Systems in Idaho, February 10-11, 2005.

SUMMARY: Animal Unit (AU) or mature cow threshold to produce 100 ton NH_3/year

Animal Unit (AU) Basis	Drylot	Free Stall/Scrape	Free Stall/Flush
	AU (100 t NH_3) Threshold		
No land app	7089	3893	2293
27% volatilization [1]	6842	3827	
80% volatilization [2]	6397	3700	
Cow Basis (1400 lbs)	Drylot	Free Stall/Scrape	Free Stall/Flush
	Total cows (100 t NH_3) Threshold		
No land app	5063	2781	1638
27% volatilization [1]	4887	2733	
80% volatilization [2]	4569	2643	

[1] *Assumes*: Expected level of N->NH_3 volatilization for: drop-hose or ground level liquid manure application

[2] *Assumes*: Expected level of N->NH_3 volatilization for: center pivot or other conventional sprinkler irrigation liquid manure application

Best Management Practices

The Rule recognizes that dairy farms are unique and that no specific BMP is appropriate for all dairy farms. Therefore, Section 764 of the Rule contains a table of BMP options. The dairy farmer must implement at least 27 points worth of BMPs under its permit by rule.

During the development of the Rule, various manure treatment systems and handling practices were evaluated for their effectiveness in reducing ammonia emissions. Many scientific studies, extension bulletins, NRCS handbooks and EPA guidance documents were referred to in preparing the professional judgment toward relative effectiveness in reducing ammonia and the allocation of points. An arbitrary point system, with a maximum of 20 points, was assigned to each practice; whereas, a practice receiving

20 points would equate to a system or practice that would result in a major reduction, approximately 70 percent, in ammonia emissions for that specific process. Each practice was rated on a year-round basis and as if all of the manure practically available for the practice was handled by the practice and variations due to normal seasonal use of each practice was taken into account in the points awarded to each BMP. Variations due to seasonal practices (such as corral harrowing or direct land application of liquid manure) and expected weather conditions have been factored into these ratings. Points awarded to land application practices assume that the practice is utilized on all manure that is applied. Points are allowed to be pro-rated to reflect actual waste treatment or handling that is occurring on each farm.

The emissions related to the management of exported manure are also addressed in the Rule. Dairy farmers, under the Rule, can "take credit" for the management of ammonia conservation practices that occur on farms (3rd parties) that receive their manure. For example, if a dairy exports all the vacuumed slurry (feces and urine) from a freestall dairy to a neighboring farm which injects the manure, a total of 25 points would be awarded: 15 for "Direct Utilization of Collected Slurry" and 10 points for "Soil Injection – Slurry," if used year-round or pro-rated to reflect the percentage of the year used. In order to take credit for activities conducted by 3rd parties, dairy farmers must keep records on the amount of exported material that left the farm and the BMP the 3rd party intends to employ.

The list of BMPs was developed to give the maximum amount of flexibility for producers to select the appropriate ammonia control practices for their farm. Producers should review the description of BMPs found in this bulletin as well as discuss their proposed plan with their Nutrient Management Planner to ensure that the proposal is not contrary to the provisions of their nutrient management plan.

Section 764 states:

Ammonia Control Practices for Idaho Dairies

System	Component		Ammonia Control Effectiveness [1]				Compliance Method[3]
			Open Lot	Freestall Scrape	Freestall Flush		
Waste Storage and Treatment Systems	Synthetic Lagoon Cover		15	20	20		1
	GeoteXtile Covers		10	13	13		1
	Solids Separation		3	3	3		3, 4
	Composting		4	4	4		1
	Separate Slurry and Liquid Manure Basins		6	10	-		1
	In-House Separation		0	12	0		1
	Direct Utilization of Collected Slurry		6	10	-		1, 3, 4
	Direct Utilization of Parlor Wastewater		10	10	10		1
	Direct Utilization of Flush Water		8	0	13		3, 4
	Anaerobic Digester		-	-	-		-
	Anaerobic Lagoon		-	-	-		-
	Aerated Lagoon		10	12	15		2
	Sequencing-Batch Reactor		15	20	20		2
	Lagoon Nitrification/Denitrification Systems		15	20	20		2
	Fixed-Media Aeration Systems		15	20	20		2
General Practices	Vegetative or Wooded Buffers (established)		7	7	7		1
	Vegetative or Wooded Buffers (establishing)		2	2	2		1
	Alternatives to Copper Sulfate		-	-	-		-
Freestall Barns	Scrape Built Up Manure		-	3	3		1
	Frequent Manure Removal		UD	UD	UD		-
	Tunnel Ventilation		-	-	-		-
	Tunnel Ventilation w/Biofilters		-	10	10		1
	Tunnel Ventilation w/Washing wall		-	10	10		3, 4
Open Lots and Corrals	Rapid Manure Removal		4	2	2		1, 2
	Corral Harrowing		4	2	2		1
	Surface Amendments		10	5	5		2
	In-Corral Composting / Stockpiling		4	2	2		1
	Summertime Deep Bedding		10	5	5		1

System	Component		Ammonia Control Effectiveness [1]				Compliance Method[3]
			Open Lot	Freestall Scrape	Freestall Flush		
Composting Practices	Alum Incorporation		12	8	6		2
	Carbon:Nitrogen Ratio (C:N) Ratio Manipulation		10	7.5	5		2
	Composting with Windrows		-	-	-		-
	Composting Static Pile		6	4.5	3		1
	Forced Aeration Composting		10	7.5	5		1
	Forced Aeration Composting with Biofilter		12	8	6		1
Land Application[2]	Soil Injection - Slurry		10	15	7.5		2
	Incorporation of manure within 24 hrs		10	10	10		2
	Incorporation of manure within 48 hrs		5	5	5		2
	Nitrification of lagoon effluent		10	10	15		3, 4
	Low Energy/Pressure Application Systems		7	7	10		1
	Freshwater Dilution		5	8	8		1, 2
	Pivot Drag Hoses		8	8	10		1
	Subsurface Drip Irrigation		10	10	12		1

Notes:

1. The ammonia emission reduction effectiveness of each practice is rated numerically based on practical year-round implementation. Variations due to seasonal practices and expected weather conditions have been factored into these ratings. Not implementing a BMP when it is not practicable to do so, does not reduce the point value assigned to the BMP, nor does it constitute failure to perform the BMP. UD indicates that the practice is still under development.

2. Land application practices assume practice is conducted on all manure; points will be pro-rated to reflect actual waste treatment; points can be obtained on exported material with sufficient documentation.

3. Method used by inspector to determine compliance:
   1=Observation by Inspector
   2=On-Site Recordkeeping Required
   3, 4=Deviation Reporting Required. Equipment upsets and/or breakdowns shall be recorded in a deviation log and if repaired in a reasonable timeframe does not constitute non-compliance with this rule.

A description of each ammonia control BMP is attached hereto as Appendix A.

How do I calculate how many BMP points I have?

Dairy farmers subject to this Rule should review the list of accepted BMPs and denote which practices they use throughout the year to manage and land apply the manure on their farm. The plan should reflect the "year-around" implementation of practices, rather than a plan for summer BMPs and another for winter BMPs. The following three examples, using the same example dairy farm, will help in determining the amount of points that should be awarded for each farm.

Example Dairy

Sweet Cream Dairy is a 2,200 freestall facility that scrapes the manure into a collection pit. The manure solids are then separated using a screw press and are windrowed and "composted" for bedding, while the liquid is stored in the lagoon. Wastewater from the parlor and holding pen is separated using a solids settling basin and the liquid drains into the lagoon. Exercise pens for the lactating cows are harrowed

daily, when weather permits. Lagoon wastewater is applied during the growing season using two center pivots, using overhead sprinklers, and 4 wheel-lines. The dairy also cleans up "unauthorized" manure from around the barns, separators, and irrigation equipment weekly. The dairy works with their nutritionist to monitor excess nitrogen through weekly milk urea nitrogen (MUN) samples. No replacement heifers or calves are kept on the facility.

Example #1

Initial BMP Point Determination:

- Composting: 4 points
  Separated solids from screw press and the settling basin are "composted" or dried without supplemental carbon sources or using rapid composting methods
- Scrape Built Up Manure: 3 points
  Weekly clean-up of "unauthorized" manure from around the barns, separators, and irrigation equipment
- Corral Harrowing: 2 points
  Farm daily harrows of exercise pens, when weather permits, and remove excess manure as necessary
- Manage Dietary Protein: 2 points
  Working with a trained nutritionist to monitor ration for excess nitrogen through the review of milk urea nitrogen (MUN) samples
- Total Points = 11 points

Example #2

Sweet Cream Dairy understands it does not have enough points to meet the 27 points required. Reviewing their options with their Nutrient Management Planner, the dairy farm considers directly composting the collected slurry from the freestall barn with imported mint tailings and straw.

BMP Point Determination for directly composting collected slurry:

- Direct Utilization of Collected Slurry: 10 points
  As an alternative to storing the slurry in the lagoon, the collected slurry is incorporated into compost
- Carbon:Nitrogen Ratio (C:N) Manipulation: 7.5 points
  Mint tailings and straw are used as carbon sources for the collected slurry. In addition to drying the slurry, the high carbon content helps to conserve ammonia (nitrogen) within the compost pile
- Previous points: 11 points
- Total Points = 28.5 points

Example #3

Rather than composting the collected slurry, Sweet Cream Dairy has contracted with several neighboring farms (3rd party receivers) to receive their manure daily during 8 months of the year. Additionally, the dairy farm hires a local hauler to inject the manure on fields specified by his neighbors. During the remaining 4 months of the year, the collected slurry is separated and the liquids are stored in the lagoon.

BMP Point Determination for directly injecting collected slurry:

- Direct Utilization of Collected Slurry: 10 x .75 = 7.5 points
  As an alternative to storing the slurry in the lagoon during 8 months of the year, the scraped slurry is exported off the farm. Points are pro-rated to reflect 8-month implementation
- Soil Injection – Slurry: 15 points x .75 = 11.25
  Manure is injected into the soil at a depth of 2 inches or greater. Points are pro-rated to reflect 8 month implementation
- Previous points: 11 points
- Total Points = 29.75 points

What if I only do a BMP for part of the year? Do I get full credit?
If the BMP can be conducted/implemented year-around, then no, the points would need to be pro-rated to reflect the number of months in which it will be used. This is the case in Example #3 where the amount of points were reduced by 25% to reflect that the collected slurry was exported for only 8 months of the year. If the practice is seasonal in nature, like corral harrowing, the total number of points would be awarded because the season reduction has already been taken into account when the points were assigned.

For more information, please contact

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Appendix A
AMMONIA CONTROL BMPS

LIQUID MANURE STORAGE AND TREATMENT

Synthetic Lagoon Cover.

Definition: Impermeable lagoon cover constructed of flexible polyvinyl chloride (PVC) or high density polyethylene (HDPE). Creates an air and water tight seal over the manure surface. Requires a vent to release carbon dioxide and methane.

Points: Open Lot - 15 points; Freestall Scrape – 20 points; Freestall Flush – 20 points
In general, open lot receives fewer points because of the relative amount of manure that would potentially go into the liquid storage structure.

Compliance: Observation.
Either present or not; recording and reporting not required. Inspector will have discretion if cover has a tear to decide if the size of the tear is affecting practice; dairy will be required to repair to maintain BMP points.

Management Considerations: Cover will result in the accumulation of nitrogen within the lagoon. Manure samples should be taken to ensure that excess nitrogen is applied to crops at appropriate rates. Vent and/or flare is required to release collected carbon dioxide and methane,

Geotextile Cover.

Definition: Permeable cover constructed of non-woven synthetic felt. Constructed to provide complete coverage over liquid surface.

Points: Open Lot - 10 pts; Freestall Scrape – 13 pts; Freestall Flush – 13 pts
In general, open lot receives fewer points because the relative amount of liquid storage is less than with the freestall.

Compliance: Observation.
Either present or not; no recording, no reporting would be required. Inspector will have discretion if cover has a tear to decide if tear was affecting practice; dairy will be required to repair or loose points.

Management Considerations: Cover will result in the accumulation of nitrogen within the lagoon. Manure samples should be taken to ensure that excess nitrogen is applied to crops

Solids Separation.

Definition: Gravity or mechanical separation system to remove manure solids from liquid waste stream. Separation pits should be cleaned on a regular basis with holding times less than one month. Separated solids from mechanical systems should be removed from the separator on a regular basis, not to exceed three days.

Points: Open Lot - 3 points; Freestall Scrape – 3 points; Freestall Flush – 3 points

Compliance: Recordkeeping - deviation log. Maintain a one-time plan or explanation of system used and how cleaning is done. Maintain a deviation log to document noncompliance with plan.

Composting.

Definition: Stacking and drying of separated manure solids or corral manure. Practice may or may not meet the carbon-to-nitrogen ratio criteria specified in Natural Resources Conservation Service Standard #317.

Points: Open Lot - 4 points; Freestall Scrape – 4 points; Freestall Flush – 4 points

Compliance: Observation.

Management Considerations: Composting is a aerobic biological process that results in the degradation of organic materials. For optimum composting conditions the carbon to nitrogen ration (C:N) should be between 30 – 40:1, and the moisture content should be between 50 – 60% moisture. No special microbes are required for sufficient composting.

Separate Slurry and Liquid Manure Basins.

Definition: Construction and use of separate holding basins/lagoons to keep parlor wastewater and corral runoff away from concentrated slurry (manure and urine). Applicable systems would include freestall scrape and open lot dairies, which scrape their feeding alleys.

Points: Open Lot - 6 points; Freestall Scrape – 10 points; Freestall Flush – 0 points
In general, open lot receives fewer points because the relative amount of liquid storage is less than the freestall scrape.

Compliance: Observation.

In-House Separation.

Definition: Specialized floor design allowing fecal material to remain in place while urine is removed.

Points: Open Lot – 0 points; Freestall Scrape – 12 points; Freestall Flush – 0 points

Compliance: Observation

Management Considerations: This practice utilizes floor designs which will segregate urine and feces from collecting in the same area within the freestall barn. Ammonia emissions are reduced through minimizing contact of time of urine and feces resulting in the conversion of urea to ammonia.

Direct Utilization of Collected Slurry.

Definition: Year-round utilization or direct application of manure slurry instead of placing collected fresh material in storage basis - includes on-farm and export systems. Direct utilization means slurry wastewater is not sent to a wastewater storage basin with the exception of a collection pit. Seasonal systems (daily during the growing season) need to pro-rate points to reflect the number of months in which the process is conducted.

Points: Open Lot - 6 points; Freestall Scrape – 10 points; Freestall Flush – 0 points

Compliance: Observation when it is working; may need deviation log in the winter time when it is not land applied.

Management
Considerations: Daily application systems should consult a nutrient management planner or a Certified Crop Advisor. Practice also includes facilities which incorporate collected slurry directly into compost windrows.

Direct Utilization of Collected (Parlor) Wastewater.

Definition: Utilization or direct application of parlor wastewater during the active growing season instead of placing collected fresh wastewater in storage basin - includes on-farm and export systems. Direct utilization means that parlor wastewater is not sent to a wastewater storage basin. Wastewater may be stored in a temporary storage (<5 days) until it is utilized and applied daily during the growing season as weather conditions allow.

Points: Open Lot - 10 points; Freestall Scrape – 10 points; Freestall Flush – 10 points

Compliance: Observation.

Management
Considerations: Daily application systems should consult a nutrient management planner or a Certified Crop Advisor and consider mixing wastewater with irrigation water during application.

Direct Utilization of Flush Waste.

Definition: Utilization or direct application of flush water during the active growing season instead of placing collected flush water in storage basin. Applicable systems would include freestall flush and open lot flush alley systems. Wastewater may be stored in a temporary storage (<5 days) until it is utilized and applied daily during the growing season as weather conditions allow.

Points: Open Lot - 8 points; Freestall Scrape – 0 points; Freestall Flush – 13 points

Compliance: Observation.

Management
Considerations: Daily application systems should consult a nutrient management planner or a Certified Crop Advisor and consider mixing wastewater with irrigation water during application.

Anaerobic Digester.

Definition: Treatment systems which anaerobically digests organic matter from the manure and converts it into methane using bacteria. The methane is then collected and may be used to generate electricity or as an alternative to natural gas. Steady supply of manure is needed - typically no change to nutrient concentration without additional treatment - also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 0 points; Freestall Scrape – 0 points; Freestall Flush – 0 points

Compliance: None

Management
Considerations: No points assigned because anaerobic digestion converts organic-nitrogen to ammonia-nitrogen. However, digestion allows for additional treatment to be conducted at lower operational costs.

Anaerobic Lagoon.

Definition: Biological earthen basis which manure is designed to decompose liquid manure without the presence of oxygen. System has a pH of 7.0 to 8.0, and sludge is designed to be removed every 5 years. Also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 0 points; Freestall Scrape – 0 points; Freestall Flush – 0 points
No points assigned because this is not an ammonia control.

Compliance: None

Management Considerations: No points assigned because anaerobic digestion converts organic-nitrogen to ammonia-nitrogen. However, digestion allows for additional treatment to be conducted at lower operational costs.

Aerated Lagoon.

Definition: Biological treatment basin designed to decompose liquid manure and nitrify ammonia in the presence of oxygen. System has a pH of 7.0 to 8.0, and sludge is designed to be removed every 5 years. Systems should utilize submerged micro-bubble systems to reduce ammonia loss. If engineering guidelines are not specified by the designer, system should be operated to maintain a dissolved oxygen concentration greater than 1.5 mg/l and an oxygen-reduction-potential (ORP) greater than 50. Quarterly monitoring of inflow and outflow nitrogen species is required to track system performance. Also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 10 points; Freestall Scrape – 12 points; Freestall Flush – 15 points
Point differences are based on the amount of material to be treated.

Compliance: Recordkeeping, Reporting Required - sensor for dissolved oxygen, oxygen-reduction-potential level; quarterly monitoring of the inflow/outflow

Management Considerations: Operational cost for lagoon aeration can be significant.

Sequencing Batch Reactor.

Definition: Single tank treatment system that allows for the sequencing of anaerobic, anoxic and aerobic conditions within the tank through the scheduling of wastewater feeding and aeration. Successful systems have been documented to reduce 85% of total nitrogen for animal wastewater. Quarterly monitoring of inflow and outflow nitrogen species is required to track system performance. Also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 15 points; Freestall Scrape – 20 points; Freestall Flush – 20 points
More points are given than aerated lagoon because of higher efficiency and operational control.

Compliance: Recordkeeping and reporting required. Seasonal monitoring of inflow/outflow will be needed.

Management Considerations: Operational cost for SBR can be high, but achieves an environmentally friendly reduction of nitrogen.

Lagoon Nitrification and Denitrification System.

Definition: Engineered lagoon modification or stand-alone system designed and operated to convert wastewater ammonia to nitrate and then to nitrogen gas. Quarterly monitoring of inflow and outflow nitrogen species is required to track system performance. Also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 15 points; Freestall Scrape – 20 points; Freestall Flush – 20 points

Compliance: Recordkeeping and reporting required. Seasonal monitoring of inflow/outflow will be needed.

Management Considerations: Operational cost for lagoon system can be high, but achieves an environmentally friendly reduction of nitrogen while potentially utilizing the existing earthen storage basin.

Fixed Media Aeration System.

Definition: Stand-alone treatment system designed and operated to convert wastewater ammonia to nitrate. Systems utilize a media or substrate on which to propagate bacterial growth. Several systems have been shown to denitrify wastewater nitrate into nitrogen gas. Quarterly monitoring of inflow and outflow nitrogen species is required to track system, performance. Also effective in reducing volatile organic compounds, biological oxygen demand**,** and odor.

Points: Open Lot - 15 points; Freestall Scrape – 20 points; Freestall Flush – 20 points

Compliance: Recordkeeping and reporting required. Seasonal monitoring of inflow/outflow will be needed.

Management Considerations: Operational cost for fixed media aeration systems are moderate compared to other aeration systems. Several systems have been shown to achieve an environmentally friendly reduction of nitrogen while reducing odor potential of treated wastewater.

GENERAL PRACTICES

Vegetative or Wooded Buffers – Established/Establishing.

Definition: Mixture of hardwood and evergreen trees or shrubs control, capture, and mix higher elevated cleaner air with lower, dust and odor laden air from the ground surface. Also effective on odor, and dust. Should be installed between production facility/lagoon and neighbors. (Established: At mature growth stage; Establishment: Planted but not at manure growth stage.)

Points:
(Established) Open Lot – 7 points; Freestall Scrape – 7 points; Freestall Flush – 7 points
(Establishment) Open Lot – 2 points; Freestall Scrape – 2 points; Freestall Flush – 2 points

Compliance: Observation

Management Considerations: NRCS Standard 380 “Windbreak/Shelterbelt Management” should be used as a guide for establishment.

Alternatives to Copper Sulfate.

Definition: Use of approved alternatives to copper sulfate as a hoof treatment and preventative measure. No effect on ammonia; significant reduction in hydrogen sulfide.

Points: Open Lot - 0 points; Freestall Scrape – 0 points; Freestall Flush – 0 points

Compliance: None

Management Considerations: However effective alternatives to copper sulfate will be in reducing odors from dairy storage basins, no direct correlation to reductions in ammonia emission have been established

FREESTALL BARNS

Scrape Built Up Manure.

Definition: Removal of build up manure around the yard and manure handling system. Specific emphasis on ends of barns, around collection pits, mixing tanks and manure loading areas. Also effective in reducing odors and fly production.

Points: Open Lot - 0 points; Freestall Scrape – 3 points; Freestall Flush – 3 points

Compliance: Observation

Frequent Manure Removal.

Definition: Practice is under evaluation at the University of Idaho and Texas A&M. No recommendation at this time.

Points: Under Development

Compliance: Under Development

Management Considerations: The effect of manure removal timing on ammonia emissions is currently showing mixed results.

Tunnel Ventilation.

Definition: Engineered mechanical ventilation system which draws fresh air into a barn through an open end wall by a slight negative pressure that is created by exhaust fans mounted at the opposite end wall.

Points: Open Lot - 0 points; Freestall Scrape – 0 points; Freestall Flush – 0 points

Compliance: None

Tunnel Ventilation with Biofilter.

Definition: Tunnel ventilation system that exhausts air into a biological biofilter for air treatment. Biofilter material should contain 50% shredded wood and 50% finished compost. System is also effective in reducing hydrogen sulfide, odor, and dust from barns.

Points: Open Lot - 0 points; Freestall Scrape – 10 points; Freestall Flush – 10 points

Compliance: Observation

Management

Considerations: Although not currently demonstrated on a dairy facility, this practice has shown significant reductions in ammonia, hydrogen sulfide, and odor emissions from swine facilities.

Tunnel Ventilation with Washing Wall.

Definition: Tunnel ventilation system that exhausts air into engineered washing wall for air treatment. Washing wall is designed to remove ammonia and dust from barn using a cascade of recycled water. Water may be acidified to increase ammonia removal. Systems are also effective in reducing odor and dust from barns.

Points: Open Lot - 0 points; Freestall Scrape – 10 points; Freestall Flush – 10 points

Compliance: Deviation Log

Management Considerations: Although not currently demonstrated on a dairy facility, this practice has shown significant reductions in ammonia, dust, and odor emissions from swine facilities.

OPEN LOTS AND CORRALS

Rapid Manure Removal.

Definition: Removal of winter time manure and corral bedding from open lot surface in spring or as quickly as practicable. Manure can then be stockpiled, composted or exported off of the dairy.

Points: Open Lot - 4 points; Freestall Scrape – 2 points; Freestall Flush – 2 points

Compliance: Observation - if the inspector is present when removal is being done; Recordkeeping - if the inspector is not present when removal is being done

Corral Harrowing.

Definition: Corral harrowing to distribute deposited manure, reshape corral surface and/or remove manure from corral surface. Harrowing should be conducted no less than three times per week when weather conditions permit.

Points: Open Lot - 4 points; Freestall Scrape – 2 points; Freestall Flush – 2 points

Compliance: Observation

Surface Amendments.

Definition: Use of liquid and dry chemical products that will bind or chemically target the conversion of urea to ammonia gas. Produce effectiveness and described use should be specified by manufacture testing. Examples of product may include, but are not limited to: alum, magnesium sulfate, acids.

Points: Open Lot - 10 points; Freestall Scrape – 5 points; Freestall Flush – 5 points

Compliance: Recordkeeping – documented with receipts for amendment orders

Management
Considerations: This practice does not include biological amendments or bacterial stimulants. Producers should consult their nutrient management planner to review the effect of any product on agronomic performance.

In-Corral Composting/Stockpiling.

Definition: Stockpiling and subsequent drying and potential decomposition of winter manure and bedding in-corral through summer and fall. Practice encourages the timely stacking and cleaning of corral surfaces. Practice cannot receive additional points through carbon-to-nitrogen ratio manipulation.

Points: Open Lot - 4 points; Freestall Scrape – 2 points; Freestall Flush – 2 points

Compliance: Observation

Summertime Deep Bedding.

Definition: Six inches of straw on an open corral surface as a one-time application. An approximate 40% reduction in ammonia emission is achieved.

Points: Open Lot – 10 points; Freestall Scrape – 5 points; Freestall Flush – 5 points

Compliance: Observation

Management
Considerations: This practice allows a layer of straw to segregate urine and feces from collecting in the same area within the open lot. Feces deposited on straw will be allowed to dry and thus shed liquids if urinated upon. Ammonia emissions are reduced through minimizing contact of time of urine and feces resulting in the conversion of urea to ammonia.

Special management will need to be taken to manage fly production within lot.

ANIMAL NUTRITION

Manage Dietary Protein.

Definition: With the assistance of a professional nutritionist, develop and follow a strategy to feed closer to National Research Council guidelines and production requirement, incorporate phase feeding or use of appropriate amino acids or enzymes.

Points: Open Lot - 2 points; Freestall Scrape – 2 points; Freestall Flush – 2 points

Compliance: Recordkeeping – documented with milk urea nitrogen analysis and receipts from protein orders

Management
Considerations: Producers should consult their nutritionist to evaluate the level of nitrogen in the rations fed on the farm.

COMPOSTING PRACTICES

Alum Incorporation.

Definition: Regular incorporation of aluminum sulfate with fresh material to reduce ammonia volatilization. Dissolved phosphorus will also be reduced in the applied product.

Points: Open Lot - 12 points; Freestall Scrape – 8 points; Freestall Flush – 6 points

Compliance: Recordkeeping – documented with receipts

Management Considerations: This practice does will increase the nitrogen content of the applied compost. Producers should consult their nutrient management planner to review the effect of any product on agronomic performance.

Carbon-to-Nitrogen Ratio Manipulation.

Definition: Management and material selection to insure that the carbon-to-nitrogen ratio is greater than 35:1 in the finished compost material. Lower carbon-to-nitrogen ratios will encourage greater ammonia volatilization. Practice should not be allocated toward "In-Corral Composting/Stockpiling."

Points: Open Lot - 10 points; Freestall Scrape – 7.5 points; Freestall Flush – 5 points

Compliance: Recordkeeping

Management Considerations: Composting is a aerobic biological process that results in the degradation of organic materials. For optimum composting conditions the carbon to nitrogen ration (C:N) should be between 30 – 40:1, and the moisture content should be between 50 – 60% moisture. Adding supplemental carbon sources will also increase porosity within the compost pile allowing for better aeration within the pile. No special microbes are required for sufficient composting.

Composting with Windrows.

Definition: Aerobic decomposition of manure or other organic materials placed in long rows. The windrows can be actively turned, passive, actively aerated windrow, or passively aerated windrow. Temperature is between 110 to 150 F, carbon-to-nitrogen ratio is 20:1 to 40:1, moisture is 40% to 60%, and pH is 5.5 to 9.0.

Points: Open Lot - 0 points; Freestall Scrape – 0 points; Freestall Flush – 0 points

Compliance: None

Management Considerations: Compost windrow should be have a pile height between 3 and 10 feet. Windrows less than 3 feet will not have sufficient insulation to maintain temperatures over 100^{o}F. Windrows with heights greater than 10 feet have been shown to have higher risks of spontaneous combustion.

Composting with Static Piles.

Definition: Engineered composting system through the aerobic decomposition of manure or other organic materials placed in long rows that are not turned/mixed but have aeration pipes installed to facilitate increased air transfer. Bulking agents such as shredded wood should be used to ensure pile porosity.

Points: Open Lot - 6 points; Freestall Scrape – 4.5 points; Freestall Flush – 3 points

Compliance: Observation

Management Considerations: Close management needs to be made when establishing static compost pile to ensure that all materials are thoroughly mixed and meet recommended guidelines. For optimum composting conditions the carbon to nitrogen ration (C:N) should be between 30 – 40:1, and the moisture content should be between 50 – 60% moisture. Adding supplemental carbon sources will also increase porosity within the compost pile allowing for better aeration within the pile. No special microbes are required for sufficient composting. For more information on static pile management, consult the "On-Farm Composting Handbook, NRAES-54"; call 607-255-7654 to order.

Force Aeration Composting.

Definition: Engineered composting method using long rows or containers where air is drawn or forced into the piles using mechanical blowers. These piles are not turned. Make sure air is dispersed evenly through the pile. Bulking agents such as shredded wood should be used to ensure pile porosity.

Points: Open Lot - 10 points; Freestall Scrape – 7.5 points; Freestall Flush – 5 points

Compliance: Observation

Management Considerations: Close management needs to be made when establishing compost pile, prior to aeration, to ensure that materials are thoroughly mixed and meet recommended guidelines. Systems can be aerated by either pushing air into the compost pile or pulling air through the pile (see practice: Force Aeration Composting with Biofilter)**.** Additionally, producers should consider temperature control aeration systems to reduce operational cost.

For optimum composting conditions the carbon to nitrogen ration (C:N) should be between 30 – 40:1, and the moisture content should be between 50 – 60% moisture. Adding supplemental carbon sources will also increase porosity within the compost pile allowing for better aeration within the pile. No special microbes are required for sufficient composting. For more information on forced aeration, consult the "On-Farm Composting Handbook, NRAES-54"; call 607-255-7654 to order.

Force Aeration Composting with Biofilter.

Definition: Engineered composting method using long rows or containers of carbon material where air is drawn through the compost and discharged into a biofilter. These piles are not turned. Bulking agents such as shredded wood should be used to ensure pile porosity.

Points: Open Lot - 12 points; Freestall Scrape – 8 points; Freestall Flush – 6 points

Compliance: Observation

Management Considerations: This specialized method of force aeration composting, pulls air through a compost pile and discharges air into a biofilter. Biofilter is comprised of half compost and half shredded wood by volume and a sprinkler system to maintain between 40 – 50% moisture within the biofilter. This practices works through filtering volatile compounds and ammonia and then allowing aerobic microorganisms to degrade the compounds.

Close management needs to be made when establishing compost pile, prior to aeration, to ensure that materials are thoroughly mixed and meet recommended guidelines. Producers should consider temperature control aeration systems to reduce operational cost.

For optimum composting conditions the carbon to nitrogen ration (C:N) should be between 30 – 40:1, and the moisture content should be between 50 – 60% moisture. Adding supplemental carbon sources will also increase porosity within the compost pile allowing for better aeration within the pile. No special microbes are required for sufficient composting. For more information on forced aeration, consult the "On-Farm Composting Handbook, NRAES-54"; call 607-255-7654 to order.

LAND APPLICATION PRACTICES

Soil Injection – Slurry.

Definition: Placement of manure slurry (manure of 8-15% solids) or separated solids beneath the soil surface with a minimum of mixing or stirring of the soil. Rate of slurry is not to exceed the Nutrient Management Plan recommendation for the actively growing crop.

Points: Open Lot - 10 points; Freestall Scrape – 15 points; Freestall Flush – 7.5 points

Compliance: Recordkeeping

Management Considerations: Injection on slurry or separated solids will reduce ammonia emissions, odor, and the potential of flies. The nitrogen value of the slurry will be 15 – 40% than if the manure was not incorporated. Producers should consult their nutrient management planner to review the effect of decreased ammonia loss on agronomic performance.

Incorporation of Manure within 24 Hours.

Definition: Tilling of field surface following liquid or solid manure application within 24 hours from the time the application of the manure begins. Also effective in reducing hydrogen sulfide emissions and fly propagation.

Points: Open Lot - 10 points; Freestall Scrape – 10 points; Freestall Flush – 10 points

Compliance: Recordkeeping – documented twice: application and incorporation dates

Management Considerations: Incorporation of manure will reduce ammonia emissions, odor, and the potential of flies. The nitrogen value of the slurry will be 15 – 40% than if the manure was not incorporated. Producers should consult their nutrient management planner to review the effect of decreased ammonia loss on agronomic performance.

Incorporation of Manure within 48 Hours.

Definition: Tilling of field surface following liquid or solid manure application within 48 hours from the time the application of the manure begins. Also effective in reducing hydrogen sulfide emissions and fly propagation.

Points: Open Lot - 5 points; Freestall Scrape – 5 points; Freestall Flush – 5 points

Compliance: Recordkeeping – documented twice: application and incorporation dates

Management

Considerations: Incorporation of manure will reduce ammonia emissions, odor, and the potential of flies. The nitrogen value of the slurry will be 15 – 40% than if the manure was not incorporated. Producers should consult their nutrient management planner to review the effect of decreased ammonia loss on agronomic performance.

Nitrification of Lagoon Effluent.

Definition: Use of an engineered aeration system, typically fixed media, to convert stored wastewater ammonia to nitrate prior to irrigation. Also effective in reducing volatile organic compounds, biological oxygen demand, and odor during application.

Points: Open Lot - 10 points; Freestall Scrape – 10 points; Freestall Flush – 15 points

Compliance: Deviation Log

Management Considerations: Similar to fixed media aeration system, however, effluent is nitrified (ammonia converted to nitrate) prior to application. This practice will not prevent losses of ammonia that occur during storage, but will conserve the nitrogen that is typically lost during and immediately following irrigation. Operational cost for fixed media aeration systems are moderate compared to other aeration systems. Several systems have been shown to achieve an environmentally friendly reduction of nitrogen while reducing odor potential of treated wastewater.

Low Pressure & Energy Application Systems (LEPA).

Definition: Center pivot and liner-move irrigation strategy that applies liquids at low pressures using drop nozzles. Larger droplets result in lower emissions but may cause infiltration problems on some soils. Designed systems and sprinkler packages should not exceed 35 psi. Low pressure overhead sprinklers and wheel lines do not qualify as LEPA technologies. Also effective on hydrogen sulfide and odor.

Points: Open Lot - 7 points; Freestall Scrape – 7 points; Freestall Flush – 10 points

Compliance: Observation

Management Considerations: Producers should consult with Certified Irrigation Designer (CID) and Nutrient Management Planner before converting non-LEPA pivots and linear move systems. Practice is not recommended on highly erodable land (HEL).

Freshwater Dilution.

Definition: Dilute irrigated wastewater by a minimum of 50% (1:1 ratio waste to fresh water) during all irrigation events. Dilutions can be made in approved mixing pond or chemigation systems.

Points: Open Lot - 5 points; Freestall Scrape – 8 points; Freestall Flush – 8 points

Compliance: Observation or Recordkeeping: Determined by system design

Management Considerations: Regardless of dilution rate, producers still need to take precautions of applying wastewater to crops close to harvest, especially those that will be used for direct human consumption.

Pivot Drag Hoses.

Definition: Low pressure application method that allows the liquid to be applied on the soil surface directly in the row. This method decreases the amount of liquid lost to wind drift, and to decrease the energy costs associated with pumping enough liquid to maintain the high pressures required for the impact heads. Systems should use pressure regulators or ball valves to regulate flow from drag hoses. Also effective on hydrogen sulfide and odor.

Points: Open Lot - 8 points; Freestall Scrape – 8 points; Freestall Flush – 10 points

Compliance: Observation

Management Considerations: Pressure regulators or valves should be used on each drop to manage flow rates from drag hose. Producers should consult with Certified Irrigation Designer (CID) and Nutrient Management Planner before converting non-drag hose pivots and linear move systems. Practice is not recommended on highly erodable land (HEL) or fields with little or no ground cover.

Subsurface Irrigation.

Definition: Specialized irrigation method that allows for precise applications of liquid to the root zone of the plant. System requires specialized filtering system to handle wastewater solids and specialized "wastewater approved" drip lines should be used to prevent clogging. Also effective on hydrogen sulfide and odor.

Points: Open Lot - 10 points; Freestall Scrape – 10 points; Freestall Flush – 12 points

Compliance: Observation

Management Considerations: In addition to using wastewater approved drip lines, special attention should be taken in the selection of filter media and selecting backwash frequencies. For more information on wastewater subsurface drip systems visit: www.oznet.ksu.edu/sdi/

The nitrogen value of the slurry will be 15 – 40% than if the manure was not incorporated. Producers should consult their nutrient management planner to review the effect of decreased ammonia loss on agronomic performance.